DECANT SYSTEM DESIGN CONSIDERATIONS

FOR

ONTARIO MINING OPERATIONS

Ontario

Ministry of the Environment

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

STATEMENT OF INTENT

The primary purpose of these guidelines is to assist Ministry staff in the execution of abatement and approvals functions. They may also be used by industry as an indication of environmental control requirements.

These guidelines are supplementary to the "Guidelines and Criteria for Water Quality Management in Ontario", the "Objectives for the Control of Industrial Wastes Discharges in Ontario", and the requirements of The Environmental Protection Act pertaining to the emmission of air contaminants and the disposal of solid wastes. Details of Provincial noise control requirements are embodied in The Model Municipal Noise Control By-Law and its supporting technical publications which contain acceptable noise level limits applicable to industrial activity.

The guidelines reflect overall Ministry policy. They should be applied recognizing specific requirements of individual sites, alternate process and abatement technology, and the need to stage programs which will achieve the Ministry's goals in a rapid but realistic manner.

allp

INTRODUCTION

The primary function of a tailings area decant system is to convey clarified wastewater from a point within the confines of a tailings area to a point outside of the tailings area. An important but secondary function of a tailings area decant system is to maintain desirable liquid levels within a tailings area.

TYPES OF DECANT SYSTEMS

Many types of decant systems find use in Ontario. The most common system employed involves a vertical decant tower (chimney) which is connected at or near its base to a horizontal (usually slightly inclined) decant tunnel (decant line; decant conduit). The decant tunnel routinely penetrates a tailings dam.

Other decant systems that, at present, find more limited use within the Province include:

(i) mechanical pumps mounted on floating platforms;

(ii) mechanical pumps mounted on fixed bases;

(iii) siphon arrangements and;

(iv) sluice-type overflows.

It is appropriate to emphasize the necessity of integrating the design and operational procedures for decant systems with the design of downstream channels and treatment works which might be overloaded or damaged by excessive flows due to operational or physical failures of the decant system.

DECANT SYSTEM FAILURES

Many tailings dam failures in Ontario have been directly attributed to the failure of a decant system.

Decant system failures can be loosely grouped as:

(a) operational failures, and
(b) physical failures.

(a) OPERATIONAL FAILURES

During an operational failure, the decant system involved usually remains intact. The system simply fails to operate in a proper manner.

The two common causes of operational failures are:

(i) plugging, and

(ii) hydraulic overloading.

Plugging of a decant system can happen anytime of the year. During the winter and early spring months, plugging is normally caused by floating blocks of ice that lodge within the decant system itself.

At other times of the year, plugging is usually caused by floating organic litter (logs, branches) and by floating mine-mill waste (oil drums, timber). In some cases, the decant system remains internally free of debris but the entrance to the system becomes blocked.

Hydraulic overloading of a decant system is most likely to occur during the early spring season when excessive quantities of meltwater (derived from accumulations of snow and ice) originate in or gain access to a tailings area over a relatively short period of time. In some cases, however, sudden violent rainstorms of unusual duration have caused decant systems to be hydraulically overloaded.

Whether the operational failure of a decant system is due to plugging or to hydraulic overloading, the end result is the same. If the malfunction is not corrected in time, the tailings area will flood and excess liquid will begin an erosive flow over the tops of the tailings dams. When this condition occurs, tailings dam failure is possible.

(b) PHYSICAL FAILURES

When a decant system physically fails, part or all of the decant system is destroyed. The situation is especially serious when the failure takes place deep within a tailings mass.

Most physical failures of decant systems can be assigned to one or more of three groups of causes:

(i) causes involving mechanical force;

(ii) causes involving chemical or electrochemical corrosion;

(iii) causes involving biological or biochemical factors.

Causes Involving Mechanical Force

During the cold months of the year, large blocks of ice floating in the decant pond can smash repeatedly against unprotected decant structures given the proper conditions. In addition, thick sheets of ice can exert enormous pressures on unprotected structures. Ice build-ups on decant structures can become dangerous due to abnormal buoyancy or weight forces on the structure as decant pond levels are allowed to rise and fall.

During the summer, a decant structure can be damaged when large floating objects such as logs come into repeated contact with the structure.

Decant systems can also be subject to the pressure exerted by overlying water and/or tailings. As the pressure increases due to ever increasing depths of tailings, a poorly designed system can fail.

Abrasion can be another factor in the failure or weakening of a decant system. Abrasion usually results when a tailings area effluent contains abnormal quantities of suspended solids; however, it can also occur when minor quantities of suspended solids in an effluent contact a decant structure over an extended period of time.

Causes Involving Chemical or Electrochemical Corrosion

In many cases, decant facilities are subject to chemical or electrochemical corrosion. This is due to the fact that many mine-mill wastewaters are quite acid (pH less than 4.0) or quite alkaline (pH greater than 8.0). When an acid or an alkaline condition prevails, a variety of materials that find common use in decant construction can either be weakened or destroyed.

Causes Involving Biological or Biochemical Factors

Biological or biochemical factors are normally involved in the deterioration (rotting) of wooden decant structures. In addition, certain types of bacteria are known to produce substances such as acids as a result of their activities and these substances have the ability, in many cases, to weaken or destroy commonly used structural materials.

GENERAL DECANT SYSTEM DESIGN GUIDELINES

The following decant design considerations are intended to apply to the decant tower:decant tunnel type of system:

(1) A decant system should be sited on a secure foundation. Whenever possible, a decant tower should be sited on bedrock.

Where a decant tower cannot be sited on bedrock, the foundation chosen must be strong enough in the long term to prevent settling.

(2) Decant systems should be engineered to adequately withstand adverse chemical and/or physical stresses.

(3) A decant system should be hydraulically sized to accept 150 per cent of the maximum waste flow expected from the active tailings area being served during a one-in-ten-year storm. However, in instances where failure involves possible major structural damage or risk to human lives, rarer occurrences such as a one-in-fifty or one-in-one hundred year storm should be used as a basis of design.

(4) The intake of a decant system should be located as far away as possible from the point of tailings discharge to the tailings area in order to avoid an overflow that is contaminated with suspended solids.

(5) The intake of a decant tower should not be so close to a dam as to cause swirling currents or eddies near the dam face.

(6) Access to the intake (or entrance) of a decant facility should be suitably provided.

(7) All decant system intakes should be equipped with trash (litter) screens in order to avoid plugging of the system by debris.

Trash screens are susceptible to plugging and therefore should be inspected and cleaned regularly.

(8) When and where practicable, a decant system intake should be equipped with a rugged baffle in order to prevent oil and other finely divided floating debris from gaining access to downstream areas.

(9) A decant system should be equipped with an adjustable intake so that the flow through the system can be varied or eliminated if necessary.

(10) A decant system should be designed to permit easy clean-out of the system should it become plugged.

(11) Decant tunnels (within a tailings mass) should be kept as short as practicable.

(12) Consideration should always be given to alternate decant methods (example: the emergency use of siphons) should the main decant structure fail.

(13) Within a tailings berm itself, a decant tunnel (pipe) should be equipped with several seepage rings in order to prevent the erosive migration of water along the outside of the tunnel (pipe) and ultimate dam failure.

(14) Routine inspection of all active decant systems should be required.

(15) Upon abandonment of a particular decant facility, the decant tunnel and decant tower should be plugged. Surface drainage from abandoned areas should be routed from the areas via cuts through bedrock and via adequately designed and protected spillways.